

ADVANCED MOLTEN CARBONATE FUEL CELL COMPONENTS

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ABSTRACT

First-generation molten carbonate fuel cell electrodes and matrices have successfully been manufactured in the sizes and quantities required for commercial production. To meet the endurance and cost goals required for commercializing MCFC technology, a change in the active area materials may be required. Several advanced components, including stabilized cathodes and strengthened anodes, have been tested in bench scale cells with improved strength, endurance, and/or performance. This paper will discuss the status of advanced MCFC component development and the work remaining before they are selected for development for full-area manufacturing.

INTRODUCTION M-C Power Corporation (MCP) was formed in 1987 to commercialize Molten Carbonate Fuel Cell (MCFC) stacks based on the cell technology and internally manifolded stack concept developed by the Institute of Gas Technology (IGT). Since then, MCP has successfully built and operated two full-area subscale (20 kW) stacks with a third starting in May 1993.

MCP is currently manufacturing the active area components for the first internally manifolded commercial MCFC stack (250 kW) using first-generation active area components. Concurrent with the efforts to scale up the manufacturing processes has been an ongoing effort at MCP and IGT to test advanced component technologies to enable MCP to meet its future cost and performance goals. The following sections discuss some of the component technologies which are being developed by MCP and IGT for future commercialization at MCP.

SELECTION CRITERION FOR COMMERCIALIZATION IGT has been testing several advanced component technologies designed to lower the cost of the fuel cell stacks and increase their endurance and performance. After successfully fabricating 100-cm² size samples, components are evaluated in bench scale cells to monitor their performance under varying operational parameters. Out-of-cell testing is also utilized to demonstrate the improvements in performance and endurance. From these tests, target microstructures are determined for optimal cell performance and endurance.

The technologies that are currently being developed for full-area testing are showing progress toward meeting the performance goals (Figure 1) and the additional criterion involving the cost and ease of fabrication. The advanced components currently being developed for full-area manufacturing at MCP are the stabilized cathode and the low Cr anode.

STABILIZED CATHODE The stabilized cathode was developed to inhibit the NiO dissolution which could result in cell shorting at the target operational times and pressures. Lowering of the NiO dissolution of stabilized cathodes was demonstrated at the 100-cm² cell size with acceptable performance (Figure 2). The dissolution behavior and cell performance of the stabilized cathode at elevated pressures will be further defined in the pressurized 100-cm² test stands at MCP and IGT. This testing will further pinpoint the target microstructure, composition, and porosimetry for optimal performance.

Process development at MCP and IGT focuses on three areas: raw materials development, tape casting specification, and heat treating parameter specification. The raw materials for manufacturing the components for 100-cm² testing had been batch manufactured at IGT. The batch process has been modified for continuous manufacturing for production of commercial quantities of the stabilized cathode materials. Tape casting has been successful using techniques developed for the first generation of components. Scale up of the heat treating procedures has been successful at the 0.1 m² level with final scale up to 1 m² occurring when modifications to MCP's existing equipment is complete.

LOW Cr ANODE The low Cr anode was developed to enable us to retain the creep strength and cell performance of the baseline anodes, with half the Cr content of the first generation Ni-Cr anodes. Raw materials manufacturing development and development of the tape casting and heat treating procedures resulted in anodes with a uniform distribution of Cr. Creep behavior and cell performance were characterized and compared to baseline at the 100-cm² level. Components of 0.1 m² area have been tape cast and sintered using the production equipment at MCP.

The target microstructures were obtained, verifying the capability of the process to meet the specification developed from bench top testing. Raw materials have been produced in lot sizes sufficient for 20 kW stack production, and scale up of the manufacturing procedures for production of full-area low Cr anodes is ongoing at MCP.

CONCLUSION MCP has selected advanced components to represent the second generation of active area components. Commercialization of the raw materials and component fabrication procedures should be completed by the beginning of next year. A full-area, subscale (20 kW) stack is planned to verify performance improvements and identify further work toward commercial stack production using these components.

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Figure 1.
Bench Scale Cell Performance of
Low Cr Anode and Stabilized Cathode
(Cell BS-TC-92-3)

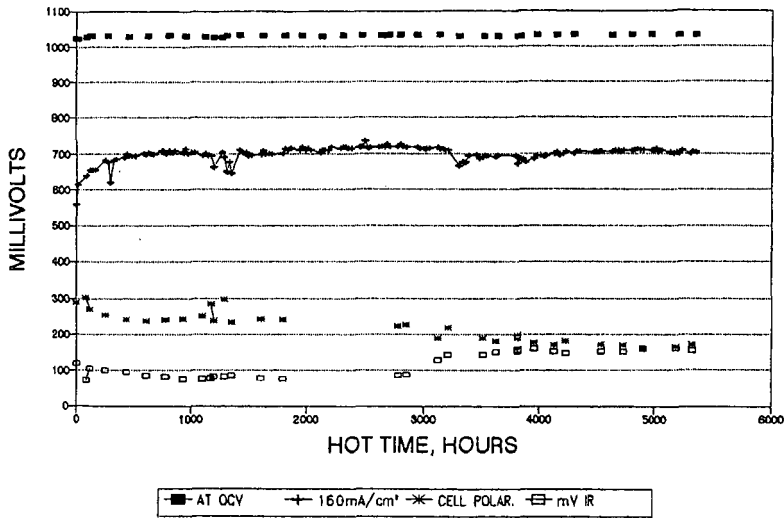


Figure 2.
Lowering of Ni Deposition in Matrix
for Cells Using the Stabilized Cathode

